West Bengal Academy of Science and Technology

REPORT

Regional Development through Science, Technology, and Innovation

PART 2

Reports prepared by:

Sectional Committee-II: Physical Sciences

Sectional Committee-VI: Plant Sciences

Sectional Committee-IX: Medical and Veterinary Sciences

Sectional Committee-X: Agriculture and Forestry

May 2026

Preamble to the Collection of Reports prepared by the Sectional Committees – Part-2

I am pleased to write this preamble to the Part–2 of the collection of reports prepared by four of the Sectional Committees of the West Bengal Academy of Science and Technology (WAST). This volume builds upon the foundational vision articulated in the Part-1 and carries forward the Academy's mission of aligning scientific excellence with the pressing developmental priorities of the State.

The legacy of pioneering scholars and institutions fostered a culture of inquiry, critical thinking, and societal engagement in the state of West Bengal. In the present era marked by climate change, technological disruption, ecological stress, demographic pressure, and evolving economic aspirations, the role of science and technology assumes even greater significance. The reports included in this volume reflect a deep introspection within the scientific community and propose forward-looking strategies rooted in evidence, interdisciplinarity, and sustainability.

The Sectional Committee - 2 on Physical Sciences emphasizes revitalizing scientific education, strengthening laboratory infrastructure, promoting interdisciplinarity, fostering collaboration among institutions, and prioritizing frontier areas such as photonics, nanotechnology, and quantum technologies. It calls for renewed engagement between scientists and policymakers to address environmental challenges and to nurture a generation equipped with both fundamental understanding and practical skills.

The Sectional Committee - 6 on Plant Sciences underscores the centrality of agriculture, biodiversity, and plant-based industries to sustainable economic development. Its recommendations range from crop diversification, climate-resilient agriculture, soil health restoration, and precision farming to the revival of tea and jute industries, conservation of indigenous plant resources, and strengthening biotechnology-driven innovation.

The report prepared by the Sectional Committee – 9 on Medical and Veterinary Sciences outlines a strategic vision for leveraging medical and veterinary sciences as key drivers of regional development in West Bengal. It highlights systemic challenges, emerging health risks, and transformative opportunities, proposing an integrated "One Health" framework to strengthen public health, enhance rural livelihoods, and promote innovation-led economic growth.

The Sectional Committee - 10 on Agriculture and Forestry provides a comprehensive analysis of the State's agrarian landscape highlighting productivity gaps, sustainability challenges, farm profitability, digital agriculture, mechanization, risk management, and the need for stronger institutional linkages. It advocates a transition toward regenerative and climate-resilient agriculture while enhancing value chains, farmer incomes, and technological integration.

Collectively, these reports converge on a common theme: the necessity of integrating knowledge systems, strengthening research-extension-policy linkages, and ensuring that science serves society in a balanced, inclusive, and sustainable manner. They recognize that development cannot be pursued in silos; rather, it requires coordinated action across education, research, industry, governance, and community participation.

Part–2 therefore represents not merely a compilation of sectoral analyses, but a coherent call to action. It urges the revitalization of scientific temper, the modernization of infrastructure, the empowerment of youth and farmers, the conservation of natural resources, and the harnessing of emerging technologies for equitable growth.

WAST remains committed to facilitating dialogue between scientists, policymakers, industry leaders, educators, and civil society. The recommendations presented herein are intended to stimulate constructive engagement, informed policy formulation, and sustained collaboration for the long-term prosperity of West Bengal.

Sivaji Chakravorti
President, WAST

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Regional Development through Science, Technology and Innovation: Part 2

Report prepared by the Sectional Committee – 2: Physical Sciences

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I. Introduction: A Legacy of Scientific Excellence

West Bengal has long been a cradle of scientific thought and innovation in India. The state has nurtured and been home to eminent scientists such as Jagadish Chandra Bose, Prafulla Chandra Ray, Meghnad Saha, Satyendra Nath Bose, Chandrasekhara Venkata Raman, Sisir Kumar Mitra, Prasanta Chandra Mahalanobis, Amal Kumar Raychaudhuri, and Bibha Chowdhuri, among many others. Their groundbreaking work spanned experimental and theoretical physics, astrophysics, ionospheric science, cosmic ray physics, statistics, chemistry, and interdisciplinary research, reflecting a rich tradition of inquiry, innovation, and excellence that continues to inspire today.

This remarkable intellectual tradition was nurtured by visionary institutions, including the University of Calcutta, Jadavpur University, Presidency College (now Presidency University), the Indian Association for the Cultivation of Science, the Saha Institute of Nuclear Physics, the Bose Institute, and the Indian Statistical Institute. These institutions fostered a culture in which teaching and research were deeply intertwined. In the early twentieth century, these institutions created a fertile environment for curiosity-driven inquiry, critical thinking, and rigorous experimentation. Close collaboration between universities and research institutes enabled students to transition seamlessly from classroom learning to frontline research.

Over time, however, systemic shifts—including changes in education policy, rising commercialization, exam-focused curricula, and employment pressures—have transformed the landscape of science education and research. Today, there is an urgent need to reimagine how Science, Technology, and Innovation (STI), particularly the physical sciences, can serve as catalysts for regional development in West Bengal. Building on this rich heritage, it is crucial to harness the strengths of physical sciences to address contemporary challenges and drive innovation-led growth.

The principal recommendations proposed by the Physical Sciences Sectional Committee of the West Bengal Academy of Science and Technology (WAST) are outlined below.

II. Science in West Bengal: Challenges and Strategic Reforms

This section presents the principal challenges and strategic reforms needed to enhance science education, research, and innovation in West Bengal.

1. **Enhancing Scientific Communication and Language Proficiency**

English is no longer perceived as merely a colonial language; it has evolved into the globally accepted medium of scientific communication. Most leading journals, international conferences, and research collaborations worldwide—including in countries such as Germany and France, now operate primarily in English.

In this context, concerns are emerging that reduced emphasis on English proficiency in parts of the school curriculum may be affecting students' national and global competitiveness. Despite strong conceptual understanding, many students encounter difficulties in national-level examinations, interviews, academic writing, and international research environments where effective English communication is essential.

It is therefore proposed that WAST engage with the Government of West Bengal to strengthen English instruction, particularly within science education at the secondary and higher secondary levels, while preserving the importance of the mother tongue. Focused initiatives in scientific writing, presentation skills, teacher development, and communication training could significantly enhance students' confidence and competitiveness.

Such efforts would not represent mere language reform, but rather an investment in empowering students from West Bengal to participate confidently in national and global scientific communities.

2. Strengthening Laboratory Infrastructure and Experimental Culture

Science—whether Biology, Chemistry, or Physics—is fundamentally experiment-driven. However, many schools and colleges continue to face (a) inadequate laboratory infrastructure (b) insufficient technical support staff (c) limited hands-on experimental exposure.

The increasing dependence on examination-oriented coaching centres has also shifted emphasis away from experimental learning toward test performance.

WAST can play a constructive role in advocating:

- Tier-based laboratory development (School → College → University)
- Provision of low-cost experimental kits for rural and under-resourced institutions
- Mandatory project-based laboratory components in undergraduate curricula

Strengthening experimental culture is essential to nurturing scientific temperament and research readiness.

3. Addressing Environmental Challenges and Scientific Responsibility

West Bengal faces serious environmental and ecological challenges, including:

- Urban air quality deterioration
- Unregulated sand mining
- Deforestation
- River erosion
- Landslides in northern districts

Although environmental science and ecology are integral components of teaching and research, sustained dialogue between scientific experts and policymakers remains limited.

Greater institutional engagement between WAST scientists and government bodies could support

evidence-based interventions in areas such as:

- Air Quality Index (AQI) monitoring and mitigation strategies
- River system and sediment transport modeling
- Sustainable resource extraction practices
- Data-driven environmental regulation and policy formulation

Scientific expertise must play a more visible and systematic role in addressing regional ecological vulnerabilities.

4. Institutional Restructuring and Upgradation

Several colleges in the state have recently been upgraded to university status. While such structural expansion is welcome, its qualitative impact must be carefully evaluated.

Key questions include:

- Has upgradation led to measurable improvement in research output?
- Has faculty strength increased proportionately?
- Has infrastructure been significantly enhanced?
- Has interdisciplinary integration improved?

A transparent, data-driven evaluation of institutional transitions should inform future restructuring decisions to ensure that expansion translates into academic excellence rather than administrative proliferation.

5. Fostering Institutional Collaboration and Partnerships

The establishment of the Indian Association for the Cultivation of Science by Mahendra Lal Sircar marked an early effort to strengthen scientific research in India, fostering intellectual engagement that worked alongside emerging university systems.

Today, collaboration between state universities and centrally funded research institutes remains limited—even where institutions are geographically proximate. Strengthening sustained institutional partnerships is therefore essential to maximizing research potential and impact.

WAST may facilitate stronger partnerships through:

- Shared laboratory facilities
- Joint doctoral supervision
- Faculty exchange programs
- Thematic research clusters and consortium-based projects

Enhanced collaboration would optimize existing resources, strengthen research ecosystems, and promote interdisciplinary innovation across the state.

III. Physical Sciences: Driving Innovation and Regional Prosperity

In today's scientific landscape, research is increasingly interdisciplinary, with major breakthroughs emerging at the intersections of physics, chemistry, biology, engineering, and computational sciences. The physical sciences, in particular, underpin advances in semiconductors, renewable energy, photonics, climate modeling, medical instrumentation, and high-performance computing. Strengthening the physical sciences is therefore not merely an academic priority, but a strategic imperative for West Bengal's regional

technological capability, industrial growth, and innovation- driven economic development.

While general reforms across education, infrastructure, and policy are essential, a **focused roadmap for the physical sciences** is critical. Physical sciences form the backbone of semiconductor technology, renewable energy, photonics, climate modeling, medical instrumentation, computational modeling, and disaster prediction, supporting innovation, technology development, and a skilled workforce. Strengthening these disciplines is therefore **not merely academic—it is foundational for regional economic and technological advancement**.

1. Identification of Strategic Domains

West Bengal's historical strengths in the physical sciences provide a foundation for focusing on strategic domains that drive innovation, industry, and societal impact. Building on this legacy, a set of high-priority strategic domains has been identified to guide research, capacity building, and regional development initiatives.

1. **Quantum Physics and Technologies** – Aligns with national priorities in quantum computing, sensing, communication, and precision measurement, positioning West Bengal in next-generation technologies.

2. **Physics of Semiconductors and Advanced Materials** – Supports electronics, manufacturing, and materials innovation, particularly in thin-film technology, nano- electronics, and new quantum materials, driving industrial growth.

3. **Green Energy and Physics** – Connects to regional sustainability goals; priority areas include solar cell materials, battery and storage physics, hydrogen technologies, grid optimization, and power electronics, enabling clean energy solutions.

4. **Statistical and Complex Systems Physics** – Provides tools to model complex phenomena in science, engineering, and social systems, including epidemic modeling, financial dynamics, urban traffic optimization, climate variability, and disaster prediction.

5. **Computational and Data -Driven Physics (including Astrophysics and Cosmology)-** Modern physics is inseparable from advanced computation and large-scale data analysis. Priority areas include high-performance computing (HPC), AI-driven modeling, large-scale simulations, data-intensive research in astrophysics, cosmology, and particle physics, and advanced detector analytics, strengthening capabilities in big-data science and global scientific collaboration.

6. **Climate and Earth System Physics** – Supports environmental monitoring, disaster management, and sustainable development. Physics-based models for delta and coastal dynamics, river sediment transport, cyclone prediction, and landslide prediction can directly inform state disaster mitigation policies.

7. **Medical Physics and Instrumentation** – Advances in radiation therapy, imaging, optical diagnostics, and biomedical instrumentation. Collaboration between physics departments and medical institutions is encouraged.

8. **Soft Matter and Interdisciplinary Physics** – Research in polymers, colloids, biological systems, and industrial materials bridges physics with chemistry, biology, materials science, and engineering, enabling cross-sector innovation.

Together, these domains form a coherent roadmap for research, capacity building, and regional

development. Building on this foundation, the following recommendations and proposals outline concrete steps to translate scientific excellence into sustainable economic and social progress.

2. Recommendations and Proposals

To translate these strategic domains into tangible outcomes, the following institutional initiatives are proposed:

- **Establish a State Quantum Research Hub** to position West Bengal at the forefront of quantum science and technology.
- **Integrate experimental and computational materials science** across physics departments to foster interdisciplinary research and innovation.
- **Create a Renewable Energy Physics Consortium** linking academia and industry to accelerate sustainable energy solutions.
- **Set up a Centre for Complex Systems and Data-Driven Modeling** to advance research in computational physics and analytics.
- **Develop a State HPC Network** connecting major institutions to enhance high-performance computing capabilities and collaborative research.

These initiatives may be implemented in a phased manner, aligned with available funding and institutional capacity.

The table below outlines the strategic domains, associated institutional initiatives, and their anticipated impact on regional development.

Strategic Domain	Action / Recommendation	Expected Impact
Quantum Physics and Technologies	Establish research hubs and incubators; promote industry-academia partnerships	Generates skilled workforce in quantum technologies
Physics of Semiconductors and Advanced Materials	Set up advanced materials labs; collaborate with electronics and manufacturing industries	Supports semiconductor-linked manufacturing potential
Physics and Green Energy	Invest in renewable energy research centers; support demonstration projects	Sustainable energy solutions, regional energy security, skill development
Statistical and Complex Systems Physics	Develop modeling and simulation centers; integrate data-driven research in regional planning	Improved decision-making, optimized industrial & societal systems

Computational and Data-Driven Physics	Establish high-performance computing facilities; support AI/ML applications	Accelerated research, innovation in data-driven solutions, tech readiness
Climate and Earth System Physics	Strengthen environmental monitoring labs; support predictive modeling for disasters	Better disaster management, climate adaptation, sustainable resource planning
Medical Physics and Instrumentation	Set up biomedical physics labs; promote development of diagnostic tools	Improved healthcare technology, regional medical innovation
Soft Matter and Interdisciplinary Physics	Encourage interdisciplinary research clusters; support translational projects	Cross-sector innovation, industrial applications, applied science growth

IV Bridging Science and Policy: WAST's Collaborative Role

In addition to the strategic recommendations outlined above, the Fellows propose that WAST proactively engage with policymakers to advance the following initiatives:

A. Strengthening Education and Curriculum Reform

1. **Curriculum Modernization for Applied Competencies**
   Reform science curricula to integrate practical orientation, computational skills, interdisciplinary exposure, and industry-aligned competencies while preserving rigorous theoretical foundations.

2. **Promotion of Experiential and Project-Based Learning**
   Encourage model exhibitions, mini-projects, demonstrations, and structured hands-on learning from the school level onward to complement classroom instruction.

3. **Integration of ICT and Digital Learning Tools**
   Facilitate the systematic use of information and communication technologies (ICT), digital simulations, and online scientific resources to enhance accessibility and engagement in science education.

4. **Prioritizing Emerging and Frontier Technologies**
   Strengthen foundational and advanced training in emerging domains such as photonics, nanotechnology, and quantum technologies to prepare students for future scientific and technological developments.

5. **Integrating Ethical and Societal Dimensions in Science Education**
   Incorporate ethical reasoning, societal responsibility, and environmental awareness into science curricula to cultivate informed, responsible, and resilient citizens.

B. Laboratory and Infrastructure Development

6. **Laboratory Upgradation and Expansion**
   Upgrade and expand laboratory infrastructure across schools, colleges, and universities to strengthen experimental culture and research capacity.

7. **Establishment of District-Level Centres of Excellence**
   Develop specialized centres in districts aligned with state and national priorities to decentralize research opportunities and promote regional scientific growth.

C. Human Resource Development and Scientific Culture

8. **Strengthening the Science Teacher Workforce**
   Build a motivated and well-trained cadre of science educators through continuous professional development, pedagogical training, and mentorship initiatives.

9. **Inspirational Lectures and Structured Mentorship Programs**
   Organize regular interactions with eminent scientists, academic leaders, and industry professionals to inspire students and provide career guidance.

10. **Celebrating Scientific Heritage and Role Models**
    Conduct inter-school, inter-college, and inter-university seminars and academic events highlighting India's scientific contributions to foster pride and aspiration among students.

D. Industry Linkages and Employability Enhancement

11. **Expanding Employment Pathways for Science Graduates**
    Strengthen research ecosystems, industry partnerships, and technology-driven sectors to create expanded employment opportunities for science graduates at the UG, PG, and doctoral levels.

12. **Industry Collaboration for Innovation and Entrepreneurship**
    Engage industry partners in developing entrepreneurial skills, start-up incubation support, and technology transfer initiatives within academic institutions.

13. **Local Engagement for Regional Aspiration and Self-Reliance**
    Promote structured interaction with successful local professionals, particularly in rural and district-level institutions, to encourage regional aspiration and support self-reliant development models.

Through these initiatives, WAST seeks to institutionalize a sustained and structured dialogue between science and policy, ensuring that the state's scientific capabilities actively inform governance, strengthen innovation ecosystems, and accelerate inclusive and sustainable regional development.

V. The Road Ahead

West Bengal stands at a crossroads: a state with a rich scientific heritage now faces critical challenges in sustaining and expanding its talent and research capacity. Reviving and advancing this heritage requires data-driven planning, physics-centered technological strategies, institutional collaboration, infrastructure modernization, and deeper integration of education, research, and industry.

A pressing concern is the recent decline in student enrolment in undergraduate science programs across the state. If unaddressed, this trend could weaken the long-term pipeline of scientists, educators, technologists, and innovators essential for regional development. Reversing this decline demands coordinated, forward-looking interventions.

Curriculum modernization is central to this effort. While preserving the rigorous theoretical foundations of physics education, undergraduate programs should incorporate computational training, data analysis, interdisciplinary electives, industry-linked projects, and exposure to emerging technological domains. Such

reforms enhance employability, strengthen student confidence, and make science education more engaging and future-ready.

Targeted measures can further strengthen student engagement and career pathways:

- **State-funded undergraduate research fellowships** to support early research exposure.
- **Industry-sponsored science scholarships** to incentivize high-performing students.
- **Integrated B.Sc.–M.Sc. research tracks** providing seamless academic and professional progression.
- **School-level science career awareness programs** to build aspiration and visibility.
- **Structured internship pipelines** in research laboratories and industry to provide practical experience.

Physical sciences must serve as a central pillar of regional development policy. Aligning scientific excellence with societal needs will strengthen technological sovereignty, environmental sustainability, and knowledge-driven economic growth. By revitalizing science education and research and integrating them with policy and industry, West Bengal can translate its intellectual capital into innovation, employment, and sustainable prosperity.

Regional Development through Science, Technology and Innovation: Part 2

Report prepared by the Sectional Committee – 6: Plant Sciences

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Plant kingdom contributes a significant role in sustaining life on earth. Almost all life forms depend on plants for their food, shelter, various medicinal and pharmaceutical compounds and many other house hold materials. Oxygen released by plants is the big source of energy for all living beings. About 80% of the world food supply is coming from plants. Unfortunately, day by day the yield of the food crops and other important crops are getting affected by issues like global warming, erratic rain pattern, pollution and water deficiency. Climate change scenario also caused appearance of new and more virulent, resistant types of pathogens that becomes more challenging for the plant scientists.

Truly speaking, food security is becoming the most demanding challenge worldwide specially for the plant scientists.

In last couple of decades, advancement of the whole genome sequencing platform facilitates identification of new genes/ promoters and transcription factors and using them for developing climate resilient crops. Plants have unique mechanism of carbon sequestration that reduces global warming. Exploitation of that machinery will be beneficial for sustainability of the planet.

Interestingly, our state is having many traditional plant varieties with climate resilient property and high nutritive value, e.g. the aromatic rice, Kalonunia, Tulaipanji etc. Due to poor yield, they are neglected.

It is a matter of great hope that now the Plant Scientists are looking for the potential gene(s)/Protein(s) of those traditional plant types and exploiting to express them in high yielding widely cultivated varieties.

One Health concept is highly significant in the context of plant life. Healthy plants provide nutritious diet to humans and other animals. Plant scientists are working in the area of Plant- pathogen, Plant- viral and plant microbe interaction to find out novel biologically safe mechanisms to protect the plants from various pathogen infection so that we have healthy products. That in turn protects the environment from the polluting effect of toxic and hazardous chemicals.

Plant associated rhizospheric microbes help the plants with better resilience against environmental stresses like drought and salinity, heavy metal contamination and attack by different soil borne pathogens. Symbiotic association of Nitrogen fixing bacteria with plants not only enrich the product with high value nutrition but also reduce the use to hazardous chemical fertilizers. Scientists have responsibility to exploit these beneficial microbes in effective manner by identifying their potentials.

Plant-Based Industries in our state

1. **Tea** is an important cash crop of West Bengal. Recently, export of Tea from Bengal is significantly suffering due to massive use of non recommended pesticides. Apart from this problem tea industry is also suffering from labour problem and other issues. To revive the industry, intervention from Government and Non-Government agencies are required. Plant scientists are needed to become more proactive to monitor and check the use of non-recommended pesticides and quality of the Tea product. Plant Scientists should be proactive to look for alternative strategies other than hazardous pesticides application to augment the pest infestation.

2. Until few decades **Jute** has been another industrially important crop of Bengal. Due to lack of proper policy at different levels, this highly valuable crop is sinking which is having vast industrially potential. As an alternative eco-friendly commodity of plastic bags, its essentiality cannot be ignored. Plant Scientists can play crucial role in developing jute variety with improved fibre quality through marker assisted /genome edited biotechnological approach.
   Moreover, currently dress materials from jute fibre are becoming very popular. Plant Scientists should apply biotechnological and genomic approaches to develop appropriate fibre quality producing jute genotypes.

Recommendation for Research and Development:

India is considered to be a highly resourceful country for its traditional knowledge based medicinal plants, highly nutritious fruits and vegetables and other industrially important compound producing plants.

Keeping in mind about the enriched traditional knowledge on values of Indian medicinal and other industrially important plants, establishment of High-quality Medicinal plant garden is recommended taking the help from Botanical Survey of India and or ICMR.

Mushroom is a high value food ingredient. Promoting a number of Mushroom cultivations set up at district level is highly recommended.

Establishment of state of art plant science research institutions with facility for third generation Genome and transcriptome sequencing facility; low-cost proteome and metabolome analyses facilities for identifying new genes/ proteins/ metabolites for improved plant development. Genome edited crop development laboratories is badly needed for high yielding, pathogen resistant varieties, developing plant breeding programs for climate-resilient crops, investigating plant-microbe interactions for improved crop health.

Recommendation for Forest Management

Deforestation is an age-old problem of Bengal which has tremendous impact on environment, e.g. global warming, changing rain pattern, disturbed animal activities. Plant scientists may take help from Forest department to stop the anthropogenic activity against nature and implement well thought out plan for restoration of the forest phytosphere.

Recommendation for Conservation and Biodiversity:

To protect and conserve native, traditional plant species by setting up of proper seed bank at district level.

Recommendation for Opening business Avenue:

Various Indian flowers like rose, chrysanthemum, lotus etc. and many ornamental plants have high market value within the country and abroad. Without having proper tissue culture as well as micropropagation facility these avenues cannot see the day light. Some kind of financial help from Govt. may advance the young, enthusiastic entrepreneurs to start working in this area which may earn revenues also for government as well as build confidence among young generation of working population.

Policy Initiatives in West Bengal for Plant Sciences:

Young working force may be properly trained under the guidance of expert plant scientists in areas of Plant tissue culture, Micropropagation of plants, conservation of seeds, Mushroom cultivation, organic farming techniques, various food processing techniques etc.

Key Performance Indicators (KPIs):

1. Increase in crop yield and productivity.
2. Conservation of native resilient, medicinally and industrially important plant species
3. Enhancement of tea and jute industry productivity qualitative and quantitatively
4. Development of new plant-based industries.
5. Well trained large population of human resource as young work force of Bengal.

By addressing these challenges and opportunities, West Bengal can harness the potential of Plant Sciences to drive agricultural growth, promote sustainable development, relatively clean and green environment which improve the quality of life for its citizens.

Regional Development through Science, Technology and Innovation: Part 2

Report prepared by the Sectional Committee – 9: Medical and Veterinary Sciences

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Prologue

West Bengal, with its rich intellectual heritage in sciences and medicine, stands at a decisive juncture to leverage its medical and veterinary sectors for comprehensive societal development. This report presents a detailed analysis of the systemic challenges and transformative opportunities within these two important sectors. This report also proposes a unified roadmap that positions healthcare excellence and the bio-economy as mainstays of the State's development strategy, aiming to improve public health, ensure food security, foster innovation-driven entrepreneurship, and generate significant skilled employment. Succeeding in this requires a concerted, multi-stakeholder effort involving the state government, academic institutions, private sector, and civil society, supported by strategic investments, policy reforms, and a culture of excellence and collaboration.

1. Introduction

West Bengal has historically been one of India's leading states of education, science, culture, and public service. With globally recognized institutions such as the Calcutta Medical College, Indian Statistical Institute, and West Bengal University of Animal and Fishery Sciences, the state has played a significant role in shaping India's medical and veterinary traditions. Despite these strengths, West Bengal today faces complex challenges in delivering equitable healthcare, advancing biomedical research, and modernizing veterinary and animal health services. Uneven delivery of services, workforce shortages in rural areas, and outmoded infrastructure limit the system's effectiveness.

West Bengal, with its large population, diverse ecology, strong academic legacy, and strategic geographic position, holds significant potential to emerge as a regional leader in these sectors. However, systemic challenges must be addressed to unlock long-term healthcare and economic benefits. West Bengal, with its strong agricultural base, dense population, and network of academic institutions, is uniquely positioned to harness its medical and veterinary sectors not just for welfare, but as a powerhouse for sustainable economic growth.

This State faces significant emerging infection threats like Nipah Virus, Dengue, Monkeypox, Avian Influenza, Japanese Encephalitis, and Scrub Typhus, especially in its northern districts, driven by geographical factors and human-animal interactions, with recent concerns also about Human Adenovirus affecting children. The "One Health" paradigm recognizes that the health of people, animals, and ecosystems is interdependent. Approximately 60% of emerging infectious diseases are zoonotic. Key challenges include managing zoonotic diseases through 'One Health' approaches, addressing mosquito-borne illnesses, controlling antimicrobial resistant strains, and implementing

stronger surveillance for viruses like Nipah and Adenovirus. Medical and veterinary sciences are not merely social sectors; they are key economic drivers. A strong healthcare ecosystem generates employment, improves workforce productivity, attracts investment, and supports allied industries such as pharmaceuticals, biotechnology, medical devices, dairy, fisheries, and animal husbandry. District hospitals often lack advanced diagnostic and specialty services, forcing patients to travel to urban centres. The state also lags behind in biomedical innovation and patent generation. Veterinary sciences are particularly critical, given thier dependence on agriculture, livestock, fisheries, and poultry for rural livelihoods. Despite strong foundations, veterinary services remain less funded, understaffed, and weakly integrated with public health planning.

2. In-depth analysis of current challenges

Though the potential is vast, accomplishment requires a perspicacious assessment of existing constraints.

2.1 Challenges in the Medical Sciences Sector

Over 70% of specialist doctors and advanced equipment are concentrated in Kolkata and other neighboring towns. However, rural and semi-urban areas experience severe shortages in primary and secondary health care infrastructure. City hospitals handle patient loads far beyond capacity, affecting the quality of care and self-confidence of physicians. Even where equipment exists, poor maintenance, lack of trained technicians, and erratic supply chains for life-saving medicines/vaccines and disposables render them ineffective. Sub-centres and Primary Health Centres often lack the manpower, diagnostics, and drugs, leading to unnecessary crowding at tertiary centres.

Medical education curricula often lag behind advancements in technology (robotics, genomics) and communication. Inclination for urban private practice, coupled with better opportunities in other Indian states or abroad, drains talent from public systems and non-metro regions. Limited protected time for faculty research, scant competitive intramural funding, and weak industry-academia links stifle translational research. Weak implementation of public health programs is an another issue. This includes challenges in monitoring and community engagement for programs addressing non-communicable diseases, vector-borne diseases, and sanitation. The regulatory bottlenecks involve delays in approvals for new hospital projects, continued support for existing projects, medical equipment import, and investments in clinical trials.

2.2 Challenges in the Veterinary & Animal Sciences Sector

There is a shortage of veterinarians and para-vets at the block and villages to take care of animal healthcare, disease surveillance, and extension services. District and sub-divisional laboratories lack advanced diagnostic capabilities and quality assurance systems. Poor integration of veterinary services with rural development programs. To coordinate “One Health", operational coordination between the animal resources development department, health department, and forest department for zoonosis control is often ad-hoc mode. Food safety challenges remain large as there is inadequate meat inspection, milk testing, and chemical/antibiotic residue monitoring throughout the farm-to-fork chain.

In the Education, Research, and Extension sectors, Post-graduate seats and super-specialty training (in fields like veterinary oncology, orthopaedics, or epidemiology) are not enough. Curriculum is not fully addressing the modern livestock/poultry industry needs, aquaculture health management, or companion animal care trends, which disconnect from industry needs.

Importantly, there is a modest focus on research on local breeds. Indigenous cattle and poultry breeds need research for genetic improvement and conservation, which is often underfunded.

Extension services fail to effectively disseminate research findings on nutrition, housing, and preventive care to farmers. Due to infections in animals, poor nutrition, and inferior genetics, livestock productivity lags behind national and global benchmarks. Lack of cold chains, processing facilities, and market linkages reduces farmers' income and increases post-harvest losses.

2.3 Cross-Sectoral Systemic Challenges

Funding is consistent under-investment in health (State health expenditure as 1.9% of SGDP) and veterinary services. But there is a lack of a unified, long-term perspective policy that aligns medical, veterinary, industry, and skill development agendas. Poor internet connectivity in rural areas impedes telemedicine, e-learning, and digital health records. An adversarial rather than collaborative relationship often exists, preventing effective partnerships.

3. Key Opportunities and strategic recommendations

3.1 Expanding Medical and Veterinary Education

Infrastructure and investment for the establishment of new medical, nursing, allied health, veterinary colleges in underserved districts, clinical trial centers and to introduce incentive-based rural postings for doctors and veterinarians. Leverage Kolkata's cost advantage, existing reputation in oncology, cardiology, and orthopaedics to attract patients from neighbouring countries (Bangladesh, Nepal, Bhutan) and the Middle East/North Africa. This requires focused accreditation, visa facilitation, and international marketing. Upgrading existing institutions into centers of excellence. Integrated MD-PhD/M.VSc-Ph.D programs will establish structured pathways to develop "Physician/Veterinarian-Scientists" capable of bridging the gap between clinical/veterinary practice and advanced laboratory research. Appropriate focus needs to be made to study the regional ethnomedicinal plants and bioactive compounds as viable components in modern therapeutics.

Strengthen collaboration between universities, research institutes, hospitals, and industry. Word class Med-tech & Bio-Incubators can be established co-located with medical colleges and engineering institutes to foster startups in affordable diagnostics, digital learning, telemedicine devices, and hospital IT. Clinical Trials Hub can be established with streamlined regulatory approvals and build capacity in Good Clinical Practice (GCP) to attract global and domestic clinical research organizations (CROs), leveraging the state's large and diverse patient pool.

Pharmaceuticals & Biosimilars could be expanded beyond manufacturing into R&D for novel drug delivery systems, capitalizing on the chemical industry base.

State One Health Institute can be established with a multidisciplinary institute linking the West Bengal University of Animal and Fishery Sciences, the Health Department, and the Environment Department for joint surveillance, outbreak investigation, and research on zoonoses (e.g., leptospirosis, scrub typhus, rabies, JE, avian flu, Nipah virus). Integrated Disease Surveillance Project (IDSP) for Animals will strengthen the animal disease reporting network, linking it to the human health surveillance system for early warning.

3.2 One Health Approach

Integration of human health, animal health, and environmental sciences to tackle zoonotic diseases.

Strengthening of surveillance systems for infectious diseases affecting humans and animals.

3.3 Biotechnology and Life Sciences Growth

Leverage Kolkata’s research ecosystem to expand biotechnology, pharmaceuticals, vaccines, and diagnostics.

Promotion of veterinary biotech (animal vaccines, feed supplements, genetics).

Funding startups and incubators focused on healthcare and agri-veterinary innovation.

3.4 Strengthening Rural Economy

Improved veterinary services can enhance livestock productivity, dairy, poultry, and fisheries.

Disease control and better animal health increase farmer incomes and food security.
Expansion of para-veterinary and animal health worker roles creates rural employment.
3.5 Medical Tourism and Health Services
Develop affordable, high-quality tertiary care hospitals. Promote West Bengal as a destination for medical education and treatment in eastern India and neighboring countries. Integrate traditional medicine, wellness, and modern healthcare services.

3.3 Enhancing Economic Output:
A mission-mode project can be launched for genetic improvement (through AI and embryo transfer), balanced ration formulation, and dairy herd management to boost milk yield.
An aqua-health park can be developed in Haldia or the coastal Sundarbans region as a hub for shrimp and fish health management, including diagnostic labs, hatchery certification, and disease-free zone development.
Entrepreneurship needs promotion in processed meat, cheese, yogurt, pet food, and leather goods through cluster development and market linkages.
Education and Services need expansion in veterinary hospitals, develop referral centres in Kolkata, Siliguri, and Asansol for advanced care in cardiology, oncology, and surgery for companion animals and livestock, creating new service markets.
Rural youths can be trained and licensed as "Veterinary Practice Managers" to run basic service units under remote supervision of veterinarians. This will address the field-level shortage.

4. Conclusion

By strategically strengthening its medical and veterinary sciences sector, West Bengal can concurrently improve public health, support rural economies, and position itself as a knowledge and innovation hub. A coordinated approach combining infrastructure development, human capital investment, research excellence, and policy reform will be key to realizing this vision.
Historical strengths in education and public service of West Bengal provide a strong foundation, but systemic challenges in medical and veterinary sciences must be urgently addressed. By investing in infrastructure, human resources, research, digital technologies, and integrated governance, the state can significantly improve healthcare outcomes while driving economic growth. A holistic, modern approach can transform West Bengal into a regional leader in healthcare and animal sciences, improving the quality of life for millions while strengthening the state’s economic resilience.

Regional Development through Science, Technology and Innovation: Part 2

Report prepared by the Sectional Committee – 10: Agriculture and Forestry

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The State of West Bengal belongs to the highly fertile lower Indo-Gangetic Plains (IGP) with very high population density (1,029 per sq. km). It accounts for ~ 2.7% of the area of the country but supports ~ 8% of her population. The net cropped area in the State is 5.21 million hectares which covers 68% of its geographical area and 92% of the arable land. There are ~ 7.12 million farm families of whom 96% are small and marginal farmers. The average size of land holding is only 0.76 ha compared to national average of 1.08 ha (2015-16). On the contrary, its unique geographical location combined with abundance of fresh water and amiable weather favouring four cropping seasons (*aaush*, *aaman*, *rabi*, and *boro*) is very congenial for all-round agricultural development. In fact, since historical time the ancient kingdom of *Vanga* was a land of prosperity with a well-developed economy in terms of agriculture, animal husbandry, shipping, trade, and commerce. The economic prosperity of the region, however, was marred by repeated invasions and destruction by Ghurids, Mughals and lastly by the colonial rulers. The Bengal Presidency of colonial India was ravaged by recurrent famines including the infamous Bengal Famine of 1943 largely due to exploitative policies of the British Raj. As a consequence, food security of India as a whole and West Bengal in particular, was at peril by the time the country achieved independence. Green revolution that emanated from the fields of Indian Agricultural Research Institute (IARI) during 1960s mitigated that threat and gradually reversed the situation from food scarcity to food surplus condition now. Agricultural growth in West Bengal also picked up in 1980s with the adoption of high yielding varieties (HYVs) and use of chemical fertilizers, that was further facilitated by exemplary agrarian reforms in the State. Since 1980s, agricultural growth has been the main contributor to overall economic growth of the State. The share of GVA from agriculture in the State's economy was 20.08% during 2024-25 compared to 17.94% in the country indicating the prominence of agriculture sector in the State even now. Nevertheless, income of farm household of the State was only ₹ 4,016/- per month as against the all-India average of ₹ 6,491/- according to 70th NSSO survey.

The State with an estimated food grain production of 18.82 million metric tonnes (MT) during 2024-25 contributed 5.49% of the country's total food grain production. Though the state has a surplus production of rice, vegetables and potatoes, a huge gap exists between the requirement and production of oilseed and pulses. The State is also a leading producer of jute, pineapple, litchi, mango and loose flowers in India.

This laudable production-oriented achievement, however, inflicted extensive degradation of agricultural land due to input-intensive nature of varieties and technologies developed during green revolution, very high cropping intensity in the State, and adverse effect of changing climate during post green revolution period that seriously impacted the sustainability of farming systems in the State. The State is located in the humid tropic, and the Bay of Bengal is close by, exposing it to the vagaries of frequent floods, cyclones and hailstorms. This is further aggravated due to exceptionally high population pressure, small and fragmented holdings, predominance of resource poor farmers with

low investment capacity, very low per capita land availability, inadequate farm mechanization, unorganized marketing structure, and historical apathy towards commercialization of agriculture.
The agriculture sector in the country is at a crossroad today due to all pervasive effect of global climate change, liberalization of global trade, national and international commitment towards sustainable development, and food safety concern under the paradigm of "One Health". On the contrary, the food demand in India is expected to rise continuously at least till 2050. Moreover, the food basket of the country is witnessing a drastic change due to economic growth, lifestyle changes and dietary preference. On the other hand, all the natural resources including soil, water, and fossil fuel are under severe constraint. It is imperative that future food production technologies should cause minimum stress on natural resources and least damage to the ecosystem. The challenge today is to produce more from less land, labour, water without contributing to degradation of natural resources. Under such complex scenario, the major challenges for the agriculture sector in the State are:

(i) A wide gap in potential and average productivity of major crops.
(ii) Declining farm profitability due to adverse terms of trade.
(iii) Nonavailability of assured quality seed, planting materials and other agricultural inputs at right time and quantity.
(iv) Insufficient processing and marketing of agricultural produce.
(v) Non-commercialization of fruits and vegetables to the optimum level and poor adoption of post-harvest technologies.
(vi) Lack of proper knowledge on assessing vulnerability and thereby failing to adopt methods to fight climate changes on agricultural production system.
(vii) Non-availability of desired credit support and crop insurance schemes.
(viii) Inadequate alliances, partnership and linkages for research and development, technology dissemination and commercialization.

We are grateful to our farmers for their devotion and innovation in agriculture, horticulture, and farm machinery, that helped our State to remain a significant contributor to making our country a food-surplus country with limited and degraded resources, despite cultivable land being encroached by urbanisation and industrialisation. However, to address the above challenges in a sustainable manner emphasis should be given on the following areas.

Sustainable agriculture: The laudable success of agriculture in West Bengal particularly after 1980s imposed unprecedented pressure on natural resources causing groundwater depletion, loss of soil fertility and health, water and air pollution due to adverse impacts of synthetic fertilisers and pesticides. The State is currently using about 68% of the total geographical area for cultivation with a cropping intensity of 182%. Moreover, West Bengal is a major flood prone State in the country with 42% of the geographical area affected by flood. On the contrary, many parts of Purulia, Bankura, Paschim Medinipur and Birbhum experience severe water shortage during summer. Soil salinity is a problem in 60 blocks of North 24 Parganas, South 24 Parganas, Midnapore (east) and Howrah districts affecting 0.44 million ha of land. Arsenic is a major contaminant in 78 blocks of Malda, Murshidabad, Nadia, North 24 Parganas, South 24 Parganas, Howrah, Hooghly and Burdwan (east); while three blocks in Birbhum district have high concentration of fluoride. It calls for gradual shift towards regenerative agriculture encouraging minimum use of synthetic inputs, thereby improving soil health in a persistent manner. To achieve that long term objective, emphasis should be given on the following aspects.

(i) Encourage multiple cropping and inter-cropping instead of monocropping in a crop sequence using naturally available ground and surface water. Incorporation of at least one pulse crop in the cropping sequence to reduce soil degradation and economize on application of chemical fertilizers in the subsequent crops.

(ii) Encourage rainfed agriculture in hills and terai region by way of sustainable watershed management approach.
(iii) Standardization of new packages of practices (PoPs) for major crops in the State based on the principles of ecology, economics, equity and employment generation emphasizing conservation agriculture, bio-intensive crop management, nutrient responsive instead of nutrient intensive agriculture, water use efficiency, integrated farming system etc.
(iv) Minimize soil disturbance during land preparation, encourage covering of soil surface with mulch or by growing crops throughout the year, encourage crop diversity, always keeping living roots in the soil, and integrating animal husbandry with crop production.
(v) Strengthening of monitoring and surveillance infrastructure to reduce the number of substandard seed, fertilizers, pesticides, biofertilizers and organic fertilizers in the market.
(vi) Creation of adequate research infrastructure for promotion of resource-conserving and regenerative agricultural practices.

Farm profitability: Despite appreciable success of agriculture sector in the State during last four decades, economic status of the farmers has not improved to the desired extent; annual income of farm household in West Bengal was ₹ 48,192 as against the all-India average of ₹ 77,892 according to 70th NSSO survey. This apparently contradictory situation is mainly due to over-dependence on cultivation of low value grain crops. The following remedial measures are suggested to improve farm profitability on long term basis.

(i) There should be a gradual shift towards high value farm products such as fruits and vegetables, milk, eggs, poultry and fisheries.
(ii) Thrust on the easy-to-use and low-cost protected-cultivation for high-value horticultural crop production and creation of effective marketing channels for such crops.
(iii) Adoption of innovative technologies for potato seed production, planting materials for commercial floriculture, medicinal plants, and easier transport mechanisms.
(iv) Appropriate research and training to develop products and production technologies suitable for export and value addition, particularly for crops with surplus production, such as rice, potato, vegetables, flowers, mango and lichi.
(v) Establishment of on-farm primary processing facilities for perishable crops.
(vi) Development of environment-friendly technologies to reduce post-harvest loss of perishables, followed by the aggressive campaign for the commercialization of fruits and vegetables to the optimum level.
(vii) The small holding size of the state is also a major contributor to low farm profitability; consolidation of farms through Farmers Producer Organization (FPO) and Farmers Producer Company (FPC) can improve profitability through better operational scale.
(viii) There is enormous scope in the State for establishment of food processing units and cold storage units in view of large-scale production of potatoes, fruits and vegetables.
(ix) The unskilled family farmers in the State should be trained to undertake post-harvest processing and packaging of farm produce, preferably on their farm itself or near to the production site. Such technologies would promote entrepreneurship development in rural areas by strengthening forward linkage in agriculture. This would generate additional working days to farm family members, add value to harvest and generate additional income.

Bridging the yield gap: There is a large yield gap in major crops from the best performing country in the world; even within the country, the State's productivity of rice, wheat, maize, pulses, and oilseeds is lower than best performing States of India (Table 1).

Table 1: Yield (t/ha) of major crops (2023)

Crop	Highest (World)*	Highest (India)**	State average
Rice	9.87 (Tajikistan)	4.57 (Meghalaya)	3.63
Wheat	9.67 (New Zealand)	4.75 (Punjab)	3.09
Maize	23.31 (UAE)	8.86 (Andhra Pradesh)	7.30
Gram	11.88 (Jordan)	2.00 (Delhi)	1.27
Arhar (Tur)	11.50 (Saint Vincent & the Grenadines)	1.86 (Bihar)	1.63
Rapeseed & Mustard	12.88 (Mustard, Malaysia), 4.34 (Rapeseed, Ireland)	1.97 (Gujarat)	1.24
Jute	10.74 (Uzbekistan)	2.70 (West Bengal)	2.70
Potato	51.45 (USA)	30.63 (Gujarat)	29.02

* FAOSTAT, Food and Agriculture Organization of the United Nations (https://www.fao.org/faostat/en/#data/QCL).

** Agricultural Statistics at a Glance 2023, Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare, Economics, Statistics & Evaluation Division (www.agriwelfare.gov.in & http://desagri.gov.in).

Emphasis should be given on the following areas for improving productivity of major crops in the State.

(i) Develop high-yielding, nutrition-rich rice, pulse, and oilseed varieties suitable for the State's high cropping intensity and shorter winter period.

(ii) Adequate and timely supply of quality inputs such as disease-free seeds of improved varieties, fertilizers, irrigation, plant protection chemicals, bio-pesticides, agricultural machinery and credit at reasonable rates to the farmers.

(iii) Soil testing and quality-testing of seeds and fertilizers should be ensured, and supply of spurious inputs should be checked.

(iv) Balanced and optimum uses of fertilizers and inputs should be promoted together with the use of organic manures and bio-fertilizers to optimize the efficiency of nutrient use.

Digital agriculture and precision farming: Modern crop husbandry in India is now gradually transforming into an information intensive enterprise. To increase agricultural productivity and encourage agri-business opportunities, the right information is required at the right time for planning and decision making. Many fascinating innovations have emerged in the areas of digital technology, space science and global positioning system (GPS), and advanced engineering technologies including sensors and unmanned aerial vehicles (UAVs) that have immense potential to address the issues related to enhancing crop productivity, reducing cost, increasing efficiency through precision farming, empowering informed decision-making, minimising pre-and post-harvest losses, improving the quality and safety of the produce, reducing greenhouse gas emissions, and promoting climate change mitigation and adaptation. Following measures should be supported for promoting digital agriculture in the State.

(i) Active research on application of digital technologies for addressing State-specific problems and quickly extending appropriate technologies preferably through ICT and AI-enabled tools to the farmers.

(ii) Agri-startups should be nurtured and encouraged to quickly extend the innovations on those areas to the farmers for revolutionizing the entire agricultural value chain in the State. This is relevant to all stakeholders in the sector including farmers, input suppliers, processors, traders, and policy makers.

(iii) To drive innovative, farmer-centric digital solutions and to ensure timely and reliable crop-related information to all farmers, the State should enable adoption of a comprehensive digital

agriculture support system integrating remote sensing data on crops, soil, weather, and water resources. In this context, the State may think of joining the national level Digital Agriculture Mission consisting of Agri Stack and Krishi Decision Support System.

Mechanization of agriculture: Cropping intensity in the State has increased tremendously during last 3-4 decades requiring more farm-power on yearly basis even for small and marginal holdings. On the contrary, there is a continuous shifting of manual labour from agriculture to other sectors that are more lucrative. This situation has created a gap between annual farm-power requirement and availability of farm labourers.

To address severe labour shortage in rural areas as well as to reduce human drudgery, appropriate farm mechanisation suitable for small and marginal farmers has become mandatory now. Farm mechanization decreases dependence of farmers on availability of manual labour, reduces his/her cost of cultivation by saving on labour cost and ensures increased productivity because of the improved agricultural practices. Moreover, it improves utilization of narrow time window available between two consecutive crops. Augmenting farm-power is thus one of the main enabling factors for enhancing agricultural productivity and increasing farmers' income.

Extensive mechanization of few labour-intensive agricultural operations like land preparation through power tiller, paddy threshing and winnowing, potato harvesting etc. have been extensively adopted by the farmers of the State. Though farm-power availability in the State has reached 2.47 KW/ha during 2024-25, it is still below the optimum level of 2.5 KW/ha as envisioned by the Government of India. To further increase farm mechanization particularly for conservation agriculture, it is necessary to promote the following measures.

(i) Popularization of paddy straw shredder and mulcher, zero tillage planters for crops like wheat, jute, maize, lentil, etc., potato planter, paddy transplanter etc.

(ii) Promote application of farm machinery for harvesting and primary processing of major crops. There is huge demand for maize harvesters, maize sheller, maize grinder, rice mill, oil mill, dal mill, seed processing machinery, solar pump sets, agricultural drone etc. in the State. Since most of the farmers in the State are small and marginal, having limited investment capability, farm mechanization should be promoted through 'Custom Hiring Centres and Farm Machinery Hub'. It will also create employment opportunities for rural youth and other entrepreneurs.

(iii) Applied research for development of State-specific technologies related to mechanization of small and marginal fam holdings, harvesting and grading of fruits and vegetables, primary on-farm processing of perishable crops etc. and their quick dissemination using digital platform.

Risk management:

(i) Frequent occurrence of natural disasters such as droughts, floods, cyclones, storms, landslides etc. in the State is a contributory factor for extreme distress and hardship among many small farmers. Agricultural insurance schemes covering all farmers and all crops should be implemented rigorously to insulate farmers from financial distress arising out of such natural disasters.

(ii) The preponderance of small and marginal farmers in the state makes them vulnerable to unscrupulous market manipulation. Appropriate policy should be formulated and implemented for market intervention at the right time to prevent unanticipated income losses, particularly among small and marginal farmers, caused by artificial market manipulation.

(iii) Similarly, to mitigate the adverse impacts of climate change, contingency crop planning, coupled with input supply arrangements, should be readily available to farmers.

Linkages for research and development: The State has two agricultural Universities (Bidhan Chandra Krishi Viswavidyalaya, Kalyani, and Uttar Banga Krishi Viswavidyalaya, Coochbehar) and one University on animal science and fishery (West Bengal University of Animal & Fishery Sciences, Mohanpur) that carry out region-specific research in addition to education and extension activities. Besides, there are Faculties at Visva-Bharati, Sriniketan, Institute of Agricultural Science under Calcutta University, Indian Institute of Technology, Kharagpur, West Bengal University of Technology, Ramkrishna Mission Vivekananda University, Neotia University, Guru Nanak Institute of Technology that undertake undergraduate and postgraduate education and research in various agriculture related disciplines. Moreover, four national level research institutes of Indian Council of Agricultural Research (CRIJAF, NINFET, CIFRI, & ATARI) and regional research centres of 12 ICAR institutes (IARI, IVRI, NDRI, NBSSLUP, CTRI, CIBA, CPCRI, CSSRI, CISH, NRCO) are located in the State that carry out region-specific research and development on diverse crops in compliance to national mandates. In addition, at district level, 23 Krishi Vigyan Kendras (KVKs) have also been established in the State for training and demonstration of the technologies developed by ICAR. The State also has nine Agricultural Training Centres (ATC), nineteen centres of Agricultural Technology Management Agency (ATMA), and several State Agricultural Research Farms, Research Stations, Zonal Adaptive Research Stations, Model Farms, and Seed Farms spread in all districts throughout the State for carrying out agricultural extension activities among the farmers. State Agricultural Management Extension and Training (SAMETI) at Narendrapur and Netaji Subhas Training Institute of Agricultural Marketing (NSTIAM) in Hooghly are functioning for long term training of farm families on organization building, capacity building, value added marketing link ups, capacity building on Farmers' Producers Organization (FPO) etc.

Most of these institutions, however, are performing their mandated task in isolated manner without proper coordination and linkage for promoting integrated farming system in the State. It is urgently necessary to promote cooperation amongst the Universities, Research Institutions, Research Farms, and Extension Centres to promote area-specific integrated farming system combining crop and animal husbandry, horticulture, fisheries, sericulture, bee keeping, floriculture etc. The State should take up a proactive approach to harness the technological advances made by the above R&D institutions to ensure profitable but sustainable development of agriculture in the State.